Predicting the Relative Impacts of Urban Development on Air Quality: A Comparative Study of the Impacts of Land Cover and Transportation

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Keywords: urban planning, land use, future emissions, air pollution, Texas

Urban areas throughout the United States that have been designated as non-attainment with respect to the National Ambient Air Quality Standard (NAAQS) for ozone must not only develop strategies for attaining the standard, but must also continue to demonstrate maintenance for future growth. Future growth due to urban development results in changes to land use, land cover, and transportation systems and consequently to biogenic and anthropogenic emissions and processes such as dry deposition, which is a physical removal mechanism for air pollutants from the atmosphere. Predicting the relative impacts of development on emissions and dry deposition is complex; the location, pattern, and intensity of current and future human activity are highly dependent on population and policy, economic trends, and technology. These processes can influence not only the magnitude of the emissions for an area, but also the composition and spatial and temporal pattern of the emissions. In addition, land cover changes due to urbanization may have different directional impacts on air quality depending upon the process considered. For example, increasing vegetation may increase biogenic emissions and possibly ozone concentrations. However, increases in vegetation generally will result in increased deposition of air pollutants, reducing air pollutant concentrations.

Because of these complexities, air quality models, such as the Comprehensive Air Quality Model with Extensions (CAMx) and the Urban Airshed Model (UAM), become essential tools for predicting an area's ability to demonstrate attainment with the NAAQS and for assessing the impacts of growth on future air quality. Primary objectives of this project are to develop methods for evaluating the air quality impacts of alternative urban growth scenarios and to apply those methods in urban areas that are broadly representative of many urban regions. This study uses the five-county Austin, Texas, metropolitan statistical area (MSA) as a case study.

The Austin area has prepared an Early Action Compact (EAC) or voluntary State Implementation Plan (SIP) under the 8-hour NAAQS for ozone. A community "visioning" project, called Envision Central Texas (ECT), has resulted in four predetermined metropolitan development scenarios for the Austin MSA based on a projected doubling of the population. Results from each ECT scenario are used to generate corresponding land use and land cover forecasts and emissions estimates. CAMx is used to evaluate the relative impacts of these changes on predicted ozone concentrations and human exposure patterns. This poster focuses on the relative air quality impacts of changes to biogenic emissions versus anthropogenic emissions, specifically from on-road mobile sources, due to future regional development. The regional development scenarios are described, along with methods for estimating emissions and results of the photochemical modeling.

This study provides the structure needed for comprehensive modeling of regional land use, transport, and air quality futures. These modeling efforts have historically been performed with little interdisciplinary collaboration. Although the case study focuses on the Austin area, Austin is typical of many urban areas that are or could be facing designation as non-attainment under the 8-hour NAAQS for ozone, and the modeling framework is applicable to other urban areas.

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